General

Guideline Title

ACR Appropriateness Criteria® acute pyelonephritis.

Bibliographic Source(s)

Nikolaidis P, Casalino DD, Remer EM, Bishoff JT, Coursey CA, Dighe M, Eberhardt SC, Goldfarb S, Harvin HJ, Lazarus E, Leyendecker JR, Lockhart ME, Majd M, Oto A, Porter C, Ramchandani P, Sheth S, Vikram R, Expert Panel on Urologic Imaging. ACR Appropriateness CriteriaÂ® acute pyelonephritis. [online publication]. Reston (VA): American College of Radiology (ACR); 2012. 6 p. [34 references]

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Spring DB, Francis IR, Casalino DD, Arellano RS, Baumgarten DA, Curry NS, Dighe M, Israel GM, Jafri SZ, Kawashima A, Leyendecker JR, Papanicolaou N, Prasad S, Ramchandani P, Remer EM, Sheth S, Fulgham P, Expert Panel on Urologic Imaging. ACR Appropriateness Criteria® acute pyelonephritis. [online publication]. Reston (VA): American College of Radiology (ACR); 2008. 5 p.

Recommendations

Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Acute Pyelonephritis

Variant 1: Uncomplicated patient.

Radiologic Procedure	Rating	Comments	RRL*
X-ray intravenous urography	1	Studies show that imaging adds little to management if the patient responds to therapy within 72 hours.	
X-ray voiding cystourethrography	1	Studies show that imaging adds little to management if the patient responds to therapy within 72 hours.	
Computed tomography abdomen and pelvis (KUB)	1	Studies show that imaging adds little to management if	

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative

Radiologic Procedure	Rating	Comments	RRL*
		the patient responds to therapy within 72 hours.	
X-ray antegrade pyelography	1	Studies show that imaging adds little to management if the patient responds to therapy within 72 hours.	
US kidneys and bladder retroperitoneal	1	Studies show that imaging adds little to management if the patient responds to therapy within 72 hours.	O
MRI abdomen and pelvis without and with contrast	1	Studies show that imaging adds little to management if the patient responds to therapy within 72 hours.	O
MRI abdomen and pelvis without contrast	1		O
CT abdomen and pelvis without and with contrast	1	If there is a role for imaging in some circumstance, this is most likely to provide the most information.	
CT abdomen and pelvis with contrast	1		
CT abdomen and pelvis without contrast	1	Studies show that imaging adds little to management if the patient responds to therapy within 72 hours. May be used in the presence of a critical diagnosis where contrast material cannot be given.	
Tc-99m DMSA scan kidney	1	Studies show that imaging adds little to management if the patient responds to therapy within 72 hours.	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Complicated patient (e.g., diabetes or immunocompromised or history of stones or prior renal surgery or not responding to therapy).

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis without and with contrast	8		
CT abdomen and pelvis with contrast	8		
US kidneys and bladder retroperitoneal with KUB	6		
CT abdomen and pelvis without			
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation

Radiologic Procedure	Rating	Comments	RRL*
contrast			
MRI abdomen and pelvis without and with contrast	6	See statement regarding contrast in the text below under "Anticipated Exceptions."	O
MRI abdomen and pelvis without contrast	4		O
X-ray voiding cystourethrography	3	Not part of initial evaluation but may be used subsequently to demonstrate clinically suspected reflux.	
Tc-99m DMSA scan kidney	3	Cannot differentiate renal parenchymal disease from perinephric process.	
X-ray abdomen and pelvis (KUB)	2	Does not provide sufficient information by itself to guide therapy.	
X-ray intravenous urography	2		
X-ray antegrade pyelography	1	Not an initial study.	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Introduction/Background

Urinary tract infections (UTIs) are among the most common infections affecting humans. In most adults, the infection is confined to the lower urinary tract (LUT), the diagnosis is established by clinical or laboratory studies, and imaging studies are not required. When the kidney itself is involved or when there is difficulty in differentiating LUT infection from renal parenchymal involvement, imaging studies are often requested, both for diagnosis and to plan management. Conditions that are thought to predispose a patient with LUT infection to renal involvement include vesicoureteral reflux, altered bladder function, congenital urinary tract anomalies, and the presence of renal calculi.

Pathologically, inflammatory disease of the kidney generally occurs as the result of ascending infection from the LUT (whether or not radiologically demonstrated vesicoureteral reflux is present) by gram-negative enteric pathogens (usually *Escherichia coli*) and is known as acute pyelonephritis. This name accurately reflects the underlying pathologic condition present (i.e., infection involving both the renal parenchyma and the renal pelvis). In the majority of patients, uncomplicated pyelonephritis is readily diagnosed clinically and responds quickly to treatment with appropriate antibiotics. If treatment is delayed, the patient is immunocompromised, or, for other poorly understood reasons, small micro abscesses that form during the acute phase of pyelonephritis may coalesce to form an acute renal abscess. If such an abscess then ruptures into the perinephric space, a perirenal abscess is formed. If the infection is confined to an obstructed collecting system, the infection is referred to as pyelonephrosis. Patients with underlying diabetes are of particular concern, as are they more vulnerable to the development of a complication from acute pyelonephritis, including renal abscesses and emphysematous pyelonephritis. Additionally, it is also more difficult to establish the diagnosis on clinical grounds in diabetics, since as many as 50% will not have the typical flank tenderness that helps to differentiate pyelonephritis from LUT infection in an otherwise healthy patient.

Prior to the advent of cross-sectional imaging, radiologic studies performed in patients with uncomplicated pyelonephritis were normal in most cases. In the early 1970s, however, a subgroup of patients was identified with acute pyelonephritis, commonly with underlying diabetes, who did

not respond quickly to therapy and in whom urography showed anatomic and severe functional abnormalities. In order to differentiate such patients from those with garden-variety pyelonephritis, a new term, acute bacterial nephritis, was coined. With the advent of cross-sectional imaging, a whole new lexicon of terminology evolved to describe various degrees of parenchymal involvement with pyelonephritis. The Society of Uroradiology has recommended that all patients with renal infection be referred to as having acute pyelonephritis, with only the additional modifiers unilateral or bilateral, focal or diffuse, focal swelling or no focal swelling, and renal enlargement or no enlargement used to describe the extent of the process.

Intravenous Urography

In the past, intravenous urography (IVU) was the primary diagnostic modality for imaging patients with renal infection. Its role has diminished, and now it plays, at best, a minor role in patients with acute pyelonephritis. The rationale for performing urography was not to diagnose acute pyelonephritis but to look for an underlying anatomic abnormality (such as a congenital anomaly) predisposing the patient to the infection, to search for an underlying process that may have prevented a rapid therapeutic response (e.g., calculus, papillary necrosis, or obstruction), or to diagnose a complication of the infection such as a renal or perinephric abscess. As such, many clinicians routinely ordered an IVU or, now with increasing frequency, computed tomography (CT) of the abdomen and pelvis in all patients with a clinical diagnosis of pyelonephritis within the first 24 hours after initiation of therapy.

It has been demonstrated that routine urography does not alter the clinical care in 90% of patients with pyelonephritis. This same study showed, however, that if investigation was confined to those patients who remained febrile after 72 hours of appropriate antibiotic therapy, the number of patients with urography findings of immediate clinical significance rose to 36%. The authors also found a five-fold increase in yield from routine urography in patients with underlying diabetes or those infected with a pathogen other than ampicillin-sensitive *Escherichia coli*.

Computed Tomography

One study confirmed the validity of waiting for 72 hours prior to obtaining imaging in a study of the utility of CT in patients with pyelonephritis. In this series, 95% of patients with uncomplicated pyelonephritis became afebrile within 48 hours of appropriate antibiotic therapy, and nearly 100% did so within 72 hours.

There is almost universal agreement that precontrast and postcontrast CT is the imaging study of choice to diagnose patients with atypical pyelonephritis or to look for a potential complication such as a renal or perinephric abscess or emphysematous pyelonephritis. It is a widely available and a sensitive method for evaluating the complications of UTIs, and it also provides a global assessment of involvement within the abdomen and pelvis. In addition to providing superior anatomic detail and improved sensitivity for detecting underlying congenital or acquired renal abnormalities, the use of intravenous contrast may provide additional functional information about the kidney. In most of the studies comparing CT with ultrasound (US), much of the superiority of CT lay in its ability to detect parenchymal abnormalities in patients with pyelonephritis that are generally missed by US.

Ultrasound

US has several advantages including low risk, wide availability, relatively low expense, lack of ionizing radiation, and the fact that it does not require the use of contrast material. Color and power Doppler should be utilized to improve the sensitivity of US in patients with acute pyelonephritis. However, US can miss subtle changes of mild pyelonephritis and often underestimates the severity of renal involvement or perinephric extension. In a recent study of 147 patients with clinically suspected acute pyelonephritis, CT showed significantly higher sensitivity than Doppler US.

With recent technical advances in US such as tissue harmonic imaging and the use of US contrast agents, the sensitivity of US to subtle parenchymal abnormalities in pyelonephritis has increased. In a study comparing contrast-enhanced US (CEUS) using the contrast pulse-sequence technique and enhanced CT in 100 patients with acute pyelonephritis, CEUS was reported to be very accurate. The authors of the study reported a sensitivity of 98%, a specificity of 100%, a low false negative rate of 2% and no false positives. This study, however, had several limitations: CT was used as the gold standard, parenchymal findings on CEUS were evaluated subjectively, and a single investigator performed all CEUS studies. Although a microbubble contrast agent is popular and widely used in Europe and Asia, the U.S. Food and Drug Administration has not approved it for general imaging in the United States. Further work in this area will also be needed to confirm the accuracy of this new technique before more specific recommendations can be considered. Conventional grayscale US is especially helpful in evaluating for hydronephrosis or pyonephrosis (i.e., low-level echoes within the collecting system), but CT may also suggest this diagnosis. The most specific test to diagnose pyonephrosis, however, is needle aspiration of the collecting system, which is generally performed as a prelude to percutaneous nephrostomy.

99m-Technetium-Dimercaptosuccinic Acid (DMSA) Renal Scintigraphy

There has been increased interest in the diagnosis of acute pyelonephritis using 99m-technetium DMSA renal scintigraphy in the pediatric

population. This is important in children since differentiating LUT infection from pyelonephritis is more difficult in the pediatric population and since it is the young who are more vulnerable to permanent renal damage from renal inflammatory disease. Studies have shown this technique to be much more sensitive for detecting pyelonephritis than US. Power Doppler US has shown sensitivities and specificities approaching 90% in children with acute pyelonephritis. Other recent studies propose routinely obtaining both renal US and DMSA scanning in children after their first febrile UTI. Of note, one study suggests that CT is more accurate than technetium 99m DMSA renal scintigraphy in detecting involvement with acute pyelonephritis in adult patients.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) and magnetic resonance urography (MRU) are felt to be useful in patients in whom the use of iodinated contrast material must be avoided, (particularly those with contrast sensitivity), but case-controlled studies fully documenting its efficacy have yet to be published. MRU also avoids exposure to radiation and combines excellent spatial resolution with assessment of renal function and drainage. Several studies comparing MRU to DMSA renal scan for the detection of pyelonephritis and renal scarring have shown MRU to be at least equivalent to DMSA scan. Using only an unenhanced T1-weighted sequence, the sensitivity and specificity of MRI to detect renal scars were 77% and 87%, respectively.

The cortical phase of contrast-enhanced MRI is likely the best sequence to detect and differentiate pyelonephritis from cortical defects. MRU can distinguish among acute pyelonephritis, renal scarring, and renal dysplasia. MRU is also useful for detecting and characterizing congenital anomalies of the kidneys and genitourinary tract in the pediatric and adult population. The use of diffusion weighted sequences is also promising, assisting in the differentiation between pyonephrosis and hydronephrosis, which may be particularly helpful for pregnant patients in the second and third trimesters.

Early studies have shown diffusion-weighted sequences to provide reproducible information regarding renal function. One potential disadvantage of MRI is its inability to detect smaller calculi, especially when the stones are not surrounded by urine.

Other Imaging Studies

Abdominal radiographs (i.e., abdomen and pelvis [KUB]) are of very limited use in the setting of acute pyelonephritis, unless large coexisting staghorn or obstructing calculi are being followed. Retrograde pyelography is of value in patients with severe infection and obstruction that cannot be demonstrated noninvasively. Antegrade pyelography can be used as an alternative to the retrograde study. Voiding cystourethrography is used to demonstrate vesicoureteral reflux, but it is generally only performed routinely in children.

Summary

- Otherwise healthy patients with uncomplicated pyelonephritis will typically need no radiologic workup if they respond to antibiotic therapy within 72 hours.
- If there is no response to therapy, CT of the abdomen and pelvis is the study of choice.
- Diabetics or other immunocompromised patients should be evaluated with precontrast and postcontrast CT within 24 hours of diagnosis, if response to therapy is not prompt.
- US should be reserved for patients in whom pyonephrosis is suspected and those patients for whom exposure to contrast or radiation is hazardous.
- All other complicated adult patients (e.g., patients with a history of stones or other urologic conditions, prior urologic surgery, repeated episodes of pyelonephritis) probably deserve early evaluation with CT.
- For patients in whom contrast-enhanced CT is contraindicated, MRI could be considered as an alternative to CT.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 m^2. For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

Abbreviations

- CT, computed tomography
- DMSA, dimercaptosuccinic acid
- KUB, kidneys, ureters, bladder
- MRI, magnetic resonance imaging
- Tc, technetium
- US, ultrasound

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☐	<0.1 mSv	<0.03 mSv
☐☐	0.1-1 mSv	0.03-0.3 mSv
☐☐☐	1-10 mSv	0.3-3 mSv
☐☐☐☐	10-30 mSv	3-10 mSv
☐☐☐☐☐	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."		

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Scope

Disease/Condition(s)

Acute pyelonephritis

Guideline Category

Diagnosis

Evaluation

Clinical Specialty

Family Practice

Infectious Diseases

Internal Medicine

Nephrology

Nuclear Medicine

Pediatrics

Radiology

Urology

Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

Guideline Objective(s)

To evaluate the appropriateness of radiologic examinations for imaging in acute pyelonephritis

Target Population

Patients with acute pyelonephritis

Interventions and Practices Considered

1. X-ray
    - Intravenous urography
    - Abdomen and pelvis (kidneys, ureters, bladder [KUB])
    - Voiding cystourethrography
    - Antegrade pyelography
2. Ultrasound (US) kidneys and bladder
    - Retroperitoneal
    - Retroperitoneal with KUB
3. Computed tomography (CT) abdomen and pelvis
    - With contrast
    - Without contrast
    - Without and with contrast
4. Technetium (Tc)-99m dimercaptosuccinic acid (DMSA) scan kidney
5. Magnetic resonance imaging (MRI) abdomen and pelvis
    - Without and with contrast
    - Without contrast

Major Outcomes Considered

Utility of radiologic examinations for imaging in acute pyelonephritis

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Literature Search Procedure

The Medline literature search is based on keywords provided by the topic author. The two general classes of keywords are those related to the condition (e.g., ankle pain, fever) and those that describe the diagnostic or therapeutic intervention of interest (e.g., mammography, MRI).

The search terms and parameters are manipulated to produce the most relevant, current evidence to address the American College of Radiology Appropriateness Criteria (ACR AC) topic being reviewed or developed. Combining the clinical conditions and diagnostic modalities or therapeutic procedures narrows the search to be relevant to the topic. Exploding the term "diagnostic imaging" captures relevant results for diagnostic topics.

The following criteria/limits are used in the searches.

1. Articles that have abstracts available and are concerned with humans.
2. Restrict the search to the year prior to the last topic update or in some cases the author of the topic may specify which year range to use in the search. For new topics, the year range is restricted to the last 5 years unless the topic author provides other instructions.
3. May restrict the search to Adults only or Pediatrics only.
4. Articles consisting of only summaries or case reports are often excluded from final results.

The search strategy may be revised to improve the output as needed.

Number of Source Documents

The total number of source documents identified as the result of the literature search is not known.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Strength of Evidence Key

Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.

Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.

Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.

Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.

Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

The topic author drafts or revises the narrative text summarizing the evidence found in the literature. American College of Radiology (ACR) staff draft an evidence table based on the analysis of the selected literature. These tables rate the strength of the evidence for all articles included in the narrative text.

The expert panel reviews the narrative text, evidence table, and the supporting literature for each of the topic-variant combinations and assigns an

appropriateness rating for each procedure listed in the table. Each individual panel member forms his/her own opinion based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development document (see the "Availability of Companion Documents" field).

Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

Description of Methods Used to Formulate the Recommendations

Modified Delphi Technique

The appropriateness ratings for each of the procedures included in the Appropriateness Criteria topics are determined using a modified Delphi methodology. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. American College of Radiology (ACR) staff distributes surveys to the panelists along with the evidence table and narrative. Each panelist interprets the available evidence and rates each procedure. The surveys are completed by panelists without consulting other panelists. The ratings are a scale between 1 and 9, which is further divided into three categories: 1, 2, or 3 is defined as "usually not appropriate"; 4, 5, or 6 is defined as "may be appropriate"; and 7, 8, or 9 is defined as "usually appropriate." Each panel member assigns one rating for each procedure per survey round. The surveys are collected and the results are tabulated, de-identified and redistributed after each round. A maximum of three rounds are conducted. The modified Delphi technique enables each panelist to express individual interpretations of the evidence and his or her expert opinion without excessive bias from fellow panelists in a simple, standardized and economical process.

Consensus among the panel members must be achieved to determine the final rating for each procedure. Consensus is defined as eighty percent (80%) agreement within a rating category. The final rating is determined by the median of all the ratings once consensus has been reached. Up to three rating rounds are conducted to achieve consensus.

If consensus is not reached, the panel is convened by conference call. The strengths and weaknesses of each imaging procedure that has not reached consensus are discussed and a final rating is proposed. If the panelists on the call agree, the rating is accepted as the panel's consensus. The document is circulated to all the panelists to make the final determination. If consensus cannot be reached on the call or when the document is circulated, "No consensus" appears in the rating column and the reasons for this decision are added to the comment sections.

Rating Scheme for the Strength of the Recommendations

Not applicable

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Selection of appropriate radiologic imaging procedures for evaluation of patients with acute pyelonephritis

Potential Harms

- The ability to detect parenchymal abnormalities in patients with pyelonephritis is generally missed by ultrasound (US). US can miss subtle changes of mild pyelonephritis and often underestimates the severity of renal involvement or perinephric extension.
- One potential disadvantage of magnetic resonance imaging (MRI) is its inability to detect smaller calculi especially when the stones are not surrounded by urine.

Gadolinium-based Contrast Agents

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 m^2), and almost never in other patients. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 m^2. For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

Qualifying Statements

Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist

in light of all the circumstances presented in an individual examination.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Nikolaidis P, Casalino DD, Remer EM, Bishoff JT, Coursey CA, Dighe M, Eberhardt SC, Goldfarb S, Harvin HJ, Lazarus E, Leyendecker JR, Lockhart ME, Majd M, Oto A, Porter C, Ramchandani P, Sheth S, Vikram R, Expert Panel on Urologic Imaging. ACR Appropriateness CriteriaÂ® acute pyelonephritis. [online publication]. Reston (VA): American College of Radiology (ACR); 2012. 6 p. [34 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

1995 (revised 2012)

Guideline Developer(s)

American College of Radiology - Medical Specialty Society

Source(s) of Funding

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Urologic Imaging

Composition of Group That Authored the Guideline

Panel Members: Paul Nikolaidis, MD (*Principal Author*); David D. Casalino, MD (*Panel Chair*); Erick M. Remer, MD (*Panel Vice-chair*); Jay T. Bishoff, MD; Courtney A. Coursey, MD; Manjiri Dighe, MD; Steven C. Eberhardt, MD; Stanley Goldfarb, MD; Howard J. Harvin, MD; Elizabeth Lazarus, MD; John R. Leyendecker, MD; Mark E. Lockhart, MD, MPH; Massoud Majd, MD; Aytekin Oto, MD; Christopher Porter, MD; Parvati Ramchandani, MD; Sheila Sheth, MD; Raghunandan Vikram, MD

Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Spring DB, Francis IR, Casalino DD, Arellano RS, Baumgarten DA, Curry NS, Dighe M, Israel GM, Jafri SZ, Kawashima A, Leyendecker JR, Papanicolaou N, Prasad S, Ramchandani P, Remer EM, Sheth S, Fulgham P, Expert Panel on Urologic Imaging. ACR Appropriateness Criteria® acute pyelonephritis. [online publication]. Reston (VA): American College of Radiology (ACR); 2008. 5 p.

Guideline Availability

Electronic copies: Available from the American College of Radiology (ACR) Web site .

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900 .

Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site .
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 1 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria®. Manual on contrast media. Reston (VA): American College of Radiology; 90 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria®. Procedure information. Reston (VA): American College of Radiology; 1 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria® acute pyelonephritis. Evidence table. Reston (VA): American College of Radiology; 2012. 10 p. Electronic copies: Available from the ACR Web site .

Patient Resources

None available

NGC Status

This summary was completed by ECRI on May 6, 2001. The information was verified by the guideline developer as of June 29, 2001. This summary was updated by ECRI on September 7, 2004. The updated information was verified by the guideline developer on October 8, 2004. This summary was updated by ECRI on February 6, 2006. This summary was updated by ECRI Institute on May 17, 2007 following the U.S. Food and Drug Administration (FDA) advisory on Gadolinium-based contrast agents. This summary was updated by ECRI Institute on June 20, 2007 following the U.S. Food and Drug Administration (FDA) advisory on gadolinium-based contrast agents. This summary was updated by ECRI Institute on July 31, 2009. This summary was updated by ECRI Institute on January 13, 2011 following the U.S. Food and Drug Administration (FDA) advisory on gadolinium-based contrast agents. This summary was updated by ECRI Institute on August 31, 2012.

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